THIRTEENTH ANNUAL

REPORT

OF

Rutgers Scientific School,

THE STATE COLLEGE

FOR THE

BENEFIT OF AGRICULTURE AND MECHANICS ARTS,

NEW BRUNSWICK, N. J.,

FOR THE YEAR 1877.

TRENTON, N. J.:
NAAR, DAY & NAAR, PRINTERS.
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Board of Visitors.

First Congressional District.

	Residences.	*Terms Expire.*
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CHALKLEY ALBERTSON, Esq.,	Haddonfield,	April 12, 1878.

Second Congressional District.

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Prof. GEORGE H. COOK, *Secretary.*

Report of State Board of Visitors.

THIRTEENTH ANNUAL REPORT OF THE BOARD OF VISITORS OF THE STATE AGRICULTURAL COLLEGE.

To His Excellency Joseph D. Bedle, Governor of the State of New Jersey:

Sir—The Board of Visitors of the New Jersey State Agricultural College beg leave to present their thirteenth annual report upon the condition of the college during the present year.

As required by law, two meetings of the Board have been held at the College in New Brunswick, in the year which has passed since the date of our last report. A number of the members of the Board have also visited and examined the farm of the Agricultural College, during the season which is just passed.

The first meeting was held at the College, December 15, 1876, and all the classes in the Scientific School were examined in their presence. In the laboratory of Analytical Chemistry they saw students from all the classes at work making analyses of chemical substances, minerals, ores, medicines, &c., and explaining their work in answer to the questions asked. In the draughting room they examined the drawings of all the students. They also witnessed the examinations of the

Junior Class in German and Analytical Geometry;
Sophomore Class in History and Chemistry;
Freshman Class in Algebra.

After the examinations were completed, they held a meeting to bring together the results of their several observations. At the close of the meeting, in which all the members expressed their views, the following resolution was passed, viz.:

"*Resolved,* That the Board of Visitors having this day attended the examinations of the students of Rutgers Scientific School, record their approval of the methods and course of instruction pursued in the Institution, and their gratification at the progress and proficiency of the students in their various studies. Special mention should be made of the superior skill shown in drawing, and of the remarkably good scholarship in German. They also desire to express their high appreciation of the faithful and able discharge of their duties by the professors."

The value of the College Farm for carrying out experiments on crops, fertilizers, tillage, feeding of stock, &c., was brought to the attention of the Board; and its importance to the people of our State was clearly presented by the Farm Committee.

A committee was appointed to memorialize the Legislature in behalf of an Agricultural Experiment Station at the College Farm, with an annual appropriation from the State for its support.

The second meeting of the Board was held at the College on the 14th of June, 1877. Examinations in the following subjects were attended by the members, viz.:

The Junior Class—Prof. Bowser, Calculus.
" " Prof. Rockwood, Astronomy.
" " Prof. Hasbrouck, Draughting.
" " Prof. Meyer, German.

The Sophomore Class—Mr. Armsby, Chemistry.
" " Prof. Atherton, English Constitution.
" " Prof. Hasbrouck, Descriptive Geometry.
" " " " Draughting.

The Freshman Class—Prof. Hasbrouck, Trigonometry.
" " Prof. Doolittle, English Literature.
" " Prof. Van Dyck, Botany,
" " Prof. Hasbrouck, Draughting.

At the close of the exercises, theses of the graduating class were read before the whole Board. The following is a list of the theses:

1. The water supply of the city of New Brunswick, by John Francis Ladley, of New Brunswick.
2. Seminary street sewer, Rahway, by Leanor Fresnal Loree, of Rahway.
3. An inclined plane on the Morris Canal, by Wm. James Nelson, of Piscataway.
4. The ferry freight bridge of the N. J. R. R. at Jersey City, by Edward Ingelow Pitman, of Rugeley, Eng.
5. Gun cotton and nitro-glycerine, by Charles Taylor Pomeroy, of Newark.
6. Roads, by Ellis Frank Potter, of Rahway.
7. Diatomaceous earth, by Edward Anderson Reiley, of Lambertville.
8. Light houses, by Wm. Maxson Stillman, of Plainfield.
9. Wear of the cliff at Long Branch and the means of its protection, by Geo. McClelland Taylor, of Holmdel.
10. The field work of the United States Coast Surtey, by Alfred Alexander Titsworth, of Dunellen.
11. The Manufacture of iron, by Isaac Van Winkle, of Passaic.
12. Illuminating gas, by Larue Vredenburgh, Springfield, Ill.
13. The Gilbert elevated railway, New York city, by Wm. Russell Whitehead, of Trenton.

The following resolutions were then passed by the Board:

"*Resolved*, That the Board have listened to the examinations of the students with great interest and satisfaction, and desire to express their approval of the course of instruction, and the thorough and effective way in which it is carried out."

They also direct it to be put on record, that in mathematics, chemistry, German, draughting and descriptive geometry, they consider the scholarships to have been exceptionally good; and,

That they have listened with pleasure and profit to the manly illustrations and discussions of the several practical topics presented in the theses, and desire to commend the students for the ability they have shown in their preparation, and to express their willingness to endorse the attainments of young gentlemen who give such evidence that they have used well their privileges in this institution. And that these papers reflect great credit in style, illustration and material upon the teachers who have trained the students.

On the 13th of June, 1877, the College Farm was visited by several members of the Board, in company with the State Board of Agriculture. The large body of farmers present went over the farm, inspecting the crops, the stock, and the new farm buildings, and the various experiments in progress. Much gratification was expressed at the condition of the drained land, and the growing crops, and the well-arranged new barns and outbuildings. The examination was creditable to the Trustees of Rutgers College, and highly instructive and encouraging to the enterprising farmers who were present.

In conclusion, the Board, in the discharge of their duties as representatives of the State, report that the obligations which the Trustees of Rutgers College entered into with the State, in accepting the government grant to Agricultural Colleges, are faithfully carried out. There is a respectable body of young men, in a thorough course of training for industrial pursuits, now at the Agricultural College. A very large sum of money has been expended by the trustees in providing and stocking a farm for the improvement of agriculture. It is incumbent on the State to meet this latter very liberal provision of the trustees, by an annual appropriation to pay the expense of carefully conducted experiments on this farm. Such experiments cannot be made by single farmers, much as they are needed, and we again recommend that a suitable appropriation be made by the State for this purpose.

We also recommend that ample provision be made to publish to the people of the State, the fact that the State has forty *free scholarships* in this institution, and that they are of great value to young men who are seeking a liberal and scientific education.

All of which is respectfully submitted.

WILLIAM PARRY,
President.

Trustees' Report.

Rutgers College,
New Brunswick, Nov. 10, 1877.

To His Excellency, Joseph D. Bedle, Governor of the State of New Jersey:

Sir: I beg leave, in behalf of the Trustees of Rutgers College, to submit the thirteenth annual report of Rutgers Scientific School, in compliance with the requirements of the act of Congress, approved July 2, 1862, and the act of the Legislature of the State of New Jersey, approved April 4, 1864.

I. THE FACULTY.

A single change has occurred in the teaching force of the Institution, during the past year, Professor Rockwood having resigned the chair of Natural Philosophy and Astronomy, and Professor George B. Merriman having been appointed in his place. Professor Merriman has had successful experience in the State University of Michigan, and more recently, in Albion College, in the same State, and brings the highest recommendations to his new field of labor. The Faculty is now constituted as follows:

Rev. Wm. H. Campbell, D. D., LL. D., President, and Professor of Moral Philosophy.

George H. Cook, Ph. D., LL. D., Vice President, and Professor of Chemistry, Natural History and Agriculture.

Rev. Theodore S. Doolittle, D. D., Professor of Rhetoric, Logic and Mental Philosophy.

John C. Smock, A. M., Professor of Mining and Metallurgy.

George W. Atherton, A. M., Professor of History, Political Economy and Constitutional Law.

Rev. Carl Meyer, D. D., Professor of French and German.

Francis C. Van Dyck, A. M., Professor of Analytical Chemistry.

Edward A. Bowser, M. S., C. E., Professor of Mathematics and Engineering.

Isaac E. Hasbrouck, A. M., Professor of Mathematics and Graphics.

George B. Merriman, A. M., Professor of Natural Philosophy and Astronomy.

II. COURSES OF STUDY AND DEGREES.

The courses of study in the Scientific School are as follows:

1. *A course of four years, in Civil Engineering and Mechanics.*

2. *A course of four years, in Chemistry and Agriculture.*

3. *A special course of two years, in Chemistry.*

4. *Post-Graduate Courses.*

The SPECIAL COURSE in Chemistry is intended for the convenience of students who wish to devote themselves exclusively to that branch of study. Greatly increased facilities have recently been provided for them in the Laboratory and Lecture Rooms, allowing the full employment of their time. On completing the course, they receive a certificate to that effect.

Provision is also made for PARTIAL STUDENTS, who may enter at any time, and elect, under the advice and direction of the Faculty, such studies as they may be found qualified to pursue, with classes already formed. Such students are subject to the general regulations and discipline of the Institution. They are required to have their time fully occupied, and to pass such examinations as may be prescribed in each case. On leaving, they receive certificates, stating the studies pursued, and the amount of work performed in each.

The two principal courses cover a period of four years each. The studies of the first two years are the same in both courses, and are arranged with special reference to the wants of young men who desire to fit themselves to become land surveyors, or to enter any department of skilled industry, but are unable to remain four years in the Institution. Students who leave at the end of this short course, receive certificates.

At the end of the two years' course, students elect whether to pursue the course in Civil Engineering and Mechanics, or that in Chemistry and Agriculture, and for the remaining two years their studies are directed with particular reference to the choice made. Some studies, however, of a general nature, such as History, English Literature, Political Economy, Moral Philosophy and others, are interspersed throughout the entire four years, in order that students may not only acquire a thorough preparation for their special pursuits in life, but may at the same time receive a liberal training which will fit them to discharge wisely and usefully, the duties of good citizenship.

Students completing either of the four years' courses, receive the degree of Bachelor of Science.

Graduates of three years' standing, receive the degree of Master of Science, in course.

The degrees of Civil Engineer and Doctor of Philosophy are conferred for distinguished professional success, or, on examination in prescribed subjects.

A schedule of the several courses of study accompanies this report.

III. POST-GRADUATE STUDIES.

In addition to these courses of study for undergraduates, several Post-Graduate courses have been arranged (and the number will be increased as occasion requires), for students who desire, after graduation, to pursue special lines of training and research.

In Chemistry, students can pursue special studies and investigations in the Analytical Laboratory, under the direction of a professor, upon subjects connected with industrial or professional life.

In Geology and Natural History, the large collections in Geological Hall, are available for extended courses of study, and can be used under the direction of a professor for special study in Geology, Mining, Metallurgy and the various branches of Engineering.

In Agriculture, the well-equipped farm and laboratories give unusual opportunities for advanced studies in this department, and every facility is afforded for their use.

In Mathematics, instruction will be given in any of the following subjects: Geodesy, with practice; Higher Mathematics (pure); Theoretical and Practical Astronomy; the use of Physical Apparatus.

In Modern Languages, the course will include Lectures on French Literature; Lectures on German Literature; Lectures on German Etymology, on German Mythology, and on the Phonology and Morphology of the Indo-Germanic Languages, as bearing on German.

In the department of Political and Social Science, provision is made for instruction in an Advanced Course in Political Economy; in the Constitutional History and Jurisprudence of the United States; in the History of the English Constitution; and in the elements of Roman Law.

These various subjects, according to the choice of students, will be arranged in courses of one, two or three years.

Students completing a full course of two years, in any two of the departments, will be entitled to the degree of Bachelor of Philosophy.

Students completing a full course of three years, in any three of the departments will be entitled to the degree of Doctor of Philosophy.

IV. TERMS OF ADMISSION.

The conditions of admission to the regular courses of study remain the same as for the last five years.

Applicants must be sixteen years of age, and of good moral character, and, if they come from other institutions, must bring a certificate of honorable dismission. They are required to pass a satisfactory examination in English Grammar and Spelling, Descriptive Geography, Physical Geography, History of the United States, Arithmetic, including the Metric System, Algebra to Equations of the second degree, and Three Books of Plane Geometry. The classes entering in September, 1879, and subsequently, will be examined in Algebra to Series; and in September, 1880, and subsequently, the whole of Plane Trigonometry will be required.

The regular examinations for admission to the Freshman Class are held on the Saturday and Monday preceding the annual commencement, and on the day before the opening of the Fall term. Candidates for advanced standing are examined in the preparatory studies, and in those already pursued by the class which they propose to enter.

V. STUDENTS.

Of the four classes now in the institution, which will be graduated in June 1877, 1878, 1879 and 1880, respectively, the Senior Class consists of six students, the Junior Class of nine, the Sophomore Class of ten, and the Freshman Class of nine; making a total of thirty-four now in attendance.

There have been in the institution, during the year fifty-seven students, of whom one was from Japan, one from England, four from the State of New York, two from the State of Pennsylvania, one from the State of Illinois, and the remaining forty-eight from the State of New Jersey, representing twelve counties, as follows:

Bergen,	1	Monmouth,	5
Essex,	3	Morris,	3
Hudson,	1	Passaic,	1
Hunterdon,	1	Somerset,	1
Mercer,	2	Union,	10
Middlesex,	19	Warren,	1

Under the law of New Jersey, designating this institution as "The State College for the Benefit of Agriculture and the Mechanic Arts," forty students from this State are entitled to free tuition for the entire course. These students are admitted on the recommendation of the superintendent of schools in each

county, and are distributed among the counties in proportion to to their representation in the Legislature, as follows:

Atlantic,	1	Middlesex,	2
Bergen,	1	Monmouth,	2
Burlington,	3	Morris,	2
Camden,	2	Ocean,	1
Cape May,	1	Passaic,	2
Cumberland,	1	Salem,	1
Essex,	6	Somerset,	1
Gloucester,	1	Sussex,	1
Hudson,	6	Union,	2
Hunterdon,	1	Warren,	1
Mercer,	2		

In cases where a scholarship is not filled by the county entitled to it, the Trustees have adopted the policy of allowing it to be filled temporarily, with the consent of the County Superintendent, by an applicant from some other county; and, in general, tuition is habitually remitted to students who are unable to pay that, in addition to the other expenses of procuring an education. The number of students who drop out of their classes, after the first year, has noticeably increased within a few years past. This is to be attributed partly to the lack of thoroughly good preparatory schools in some sections of the State, and partly to the higher standard of requirements which the Institution is constantly endeavoring to maintain. It is impossible for the Institution to lower its present standard, without greatly lessening the value and efficiency of its work, and the only available remedy, therefore, for the evil just mentioned, is to be sought in the improvement of the preparatory schools of the State. This, we have good reason to hope, will gradually be secured.

VI. SPECIAL DEPARTMENTS.

The general policy of the Institution, as aiming to unite the essentials of a "liberal and practical education" with the requirements of special scientific training, has been so often set forth in these reports, that it seems unnecessary to dwell upon it at the present time. But it may be of interest to show somewhat more fully than has formerly been done, the method and scope of work in some special department.

1. THE MATHEMATICAL COURSE.

In Mathematics, students during the first two years are occupied with Algebra, Geometry, Trigonometry, &c., and have sufficient field practice to make them familiar with the use of

surveyor's instruments. Those who take what is known as the Engineering Course, for the full term of four years, are instructed in the various branches of Higher Mathematics, Mechanics and Engineering, having, at the same time, daily practice in Draughting. The aim of the instruction is to make good draughtsmen, and to give the student a clear idea of the elements of the Higher Mathematics and a knowledge of the theory of Engineering, so that, after graduation, he may be able to pursue, understandingly and continuously, an advanced course of mathematical study, or to go into the field or the office as an engineer's assistant, and do good, sound, reliable work. For two or three years past, some students in this department have been employed on the Geodetic Survey of New Jersey, with highly satisfactory results. Having previously received instruction in the theory of Geodetic surveying, they are found to be worth far more, for practical work, than those who enter the field with a less complete mental equipment. The instructors in this course do not profess to make practical engineers, but to lay the foundation on which alone practical success can be assured.

2. GRAPHICS.

The increased attention which has recently been given to the important subject of Draughting, was mentioned in our report of last year. Students receive daily practice in this branch of their mathematical training, during the entire course, though the instruction, except in case of those who make it a specialty, is necessarily limited to an outline of the various applications of the draughtman's knowledge and skill. During the Freshman year the first aim is that students shall acquire some skill in the use of instruments, without which neat and rapid work is impossible, no matter how complete may be one's knowledge of theoretical principles. At the same time, they are employed in the graphical solution of problems in practical Plane Geometry, thus confirming and broadening former knowledge by giving it practical application in new directions. The principles and practice of coloring, mapping and general topographical drawing occupy the remaining time of the first year.

The Sophomore Class is directed in the solution of original problems in practical solid Geometry—obtaining in the draughting room a comprehension of the purposes and possibilities of Descriptive Geometry by a practical application of its principles, which makes it a positive power to them. These problems, with others in the intersection of surfaces, furnish the student with methods for the solution of questions in stone cutting, bridge building, &c. Construction of problems in shades and shadows and linear perspective completes the work of the Sophomore year.

During the next year, the student has practice in the æsthetical applications of draughting; and in the Senior year the whole previous course of training is summed up and given expression in various constructions of finished drawings of machinery, works of engineering, &c., which also call upon knowledge previously acquired in the lecture rooms. The drawings to illustrate the theses of the last graduating class were made by the authors, partly in the course of their regular duty in the draughting room, and partly by extra work.

It is to be regretted that all public and private schools in the State do not include in their curriculum a course of instruction in the use of draughting instruments—particularly in the solution of elementary problems in Plane Geometry. This would not only relieve the course in college of elementary instruction which properly belongs to the preparatory school, but would furnish those who do not pursue a higher course of technical education with an additional means of investigation, and of communicating ideas, the value of which is not yet appreciated as it deserves to be. He who can draw readily and well has acquired a new language, which can be comprehended by all, of whatever grade of intelligence. He has "the universal language."

As for those who enter a technical school or college, such a course of previous instruction would save them much time, which becomes more valuable as it can be employed in the higher and more interesting grades of instruction.

The Grammar School, connected with Rutgers College, has such a course of drawing, and its beneficial effects upon its students are very marked. At the same time, it creates a disparity of knowledge and skill between students who enter college from that institution and others not thus prepared, which is a source of serious embarrassment in directing the draughting of the first College Term.

3. ANALYTICAL CHEMISTRY.

Three rooms in the Geological Hall are at present devoted to chemical analysis. These, with the annexed balance room and store rooms, occupy most of the first floor of the building.

During the current year an important addition has been made to the working facilities of the department, by devoting a separate room and special tables to blowpipe analysis. The former plan of limiting the opportunity for work to the regular college hours has been found unsatisfactory, and students are now allowed to spend the entire day at analysis.

Each new student is drilled in blowpipe analysis until he is competent to determine minerals, ores, etc., with a minimum of appliances, after which qualitative analysis is entered upon.

In this the students are at first trained to the necessary manual dexterity, and instructed in the principles of the science in a general way; afterwards they are encouraged to pursue special lines of investigations having a bearing upon their prospective pursuits.

Quantitative analysis, assaying and original work follow the qualitative drill. The Seniors of the regular course, who elect Analytical Chemistry, choose topics for their theses which necessitate laboratory work. Throughout their studies the learners are encouraged to go beyond their ordinary text books for information.

The teachers in charge allow a free reference to their own books, and the college library is open daily for consultation. The fundamental idea of the plan of instruction is to make students independent, by teaching them not only what a routine analyst ought to know, but also the proper use of the books upon the subject. Inasmuch as many students in the regular course intend to pursue Medicine, Law, Agriculture, etc., and hence will not be likely to make analyses themselves, they are taught to know when and how to have analyses made, and impressed with the idea that the habits of exactness and system acquired in a laboratory are important elements of mental training.

Special students in Chemistry are, of course, expected to spend more time at work, and to acquire greater facility. We have good reason to believe that any one, on leaving the laboratory after a full course, is competent to devote himself to any line of business connected with chemistry, without further need of instruction. Certain it is that medical students invariably say that their course at College has proved invaluable to them. By degrees it is becoming more evident to the public that a rapid and thorough development of the industrial resources of our country, demand not only a trained class of workers, but a spread of scientific information among the masses, in order that opportunities for employing specialists to advantage may not pass unobserved.

Practical chemists must necessarily spend most of their time in the laboratory. The farmers and men engaged in industrial pursuits generally, ought to know what chemists can do, and ought to be able to judge pretty nearly when a chemist's aid is advantageous. The aim, then, is to teach analysis, both as a means of educational discipline and as a useful art.

There are now thirty students engaged in chemical analysis, of whom five are special students.

4. THE MUSEUM.

The Museum of the College occupies the second and third stories of Geological Hall, consisting of one large room with

galleries and store rooms at the south end. The main room is 90x40 and 25 feet high. Large windows on both sides and at the north end give an abundance of light, and so distribute it that everything is exhibited to the best advantage. On each side, under the galleries, there are seven double cases, so placed as to make an alcove at each window. These are sufficiently large to admit narrow, open cases in front of each window, whenever additional space for the exhibition of specimens is demanded. These side cases contain drawers below and shelves above. The former serve for the storage of duplicates, the latter hold those on exhibition. The cases on the east side are devoted to Mineralogy and Metallurgy. Of these, one is filled with a complete collection of minerals for the use of students of Min eralogy. They furnish materal for use in blow-pipe analysis, for the ordinary chemical examinations, and for the illustration of the general principles of Mineralogy, as crystallization, &c. Here are small suites showing degrees of hardness, electrical characters, magnetic properties, cleavage, &c. Three of the side cases are filled with larger and better examples of minerals, arranged according to the system of Dana. These can be studied, under special arrangements, by more advanced students. The collection is good and equal to the wants of elementary instruction and for post graduates to an advanced position. Three cases are filled with ores of the various metals—one containing iron ores, a second those of zinc (including handsome specimens from the celebrated mines of Sterling Hill and Franklin Furnace), and the third with native gold and silver, and ores of copper, lead, nickel, antimony and other metals. Among the copper compounds there is a very fine collection from the mines of Chili, South America, the gift of Miss Evans of New Brunswick.

The west side cases hold a part of the Paleontological and Geological collections, grouped according to their age. One case contains specimens which illustrate the formation and structure of rocks. These occupy the shelves and are always to be seen by the student of Geology. Below them is a suite of 500 specimens from Dr. Krantz, of Bonn, also for students' use. They represent by typical examples all the geological ages and periods and give a general notion of the succession of the formations of the earth. In the remaining cases the characteristic rocks and fossils of the Silurian, Devonian, Carboniferous, Triassic, Cretaceous and Tertiary and Recent ages are so arranged that the various changes in the condition of the earth and its animal and vegetable life, are traced from the eozoön of the Archaic rocks to the frail shells that are to-day filling up our lakes and marshes with shell marl. Two large glass cases in the centre of the room, a recent gift of Hon. A. Q. Garretson, Jersey City, contain typical specimens of the rocks, ores, marls, clays, sands and other native minerals of New Jersey, which are used in manufactures and agriculture. This

collection is largely a duplicate of that exhibited by the Geological Survey at the Centennial Exposition at Philadelphia. It presents to the view of the student the varied natural resources of a State. Another case on the main floor is filled with mastodon remains. These are, a very large tusk from Ellenville, New York, and a skeleton from Salem county, New Jersey. As soon as the necessary funds are procured it is designed to set up this skeleton, which, when mounted, will be the most striking object in the Museum. For illustrating iron working, two donations lately received are particularly noticeable. One of these is a collection of T irons from the Trenton Iron Company; the other a similar collection of T irons, and of rails, from the Union Iron Company of Buffalo, New York. Many other Metallurgical specimens in iron, zinc, copper, lead, nickel, silver, and gold, show how these metals are obtained from their ores, and form a valuable nucleus for a Metallurgical cabinet.

The few specimens of recent birds and animals occupy two large cases. This very important department is in need of large additions.

The conchological collection has been recently classified and beautifully arranged, by George W. Tryon, of Philadelphia, in a series of flat cases running around the sides of the gallery. The collection is large, and equal to the needs of the most advanced collegiate course. It is well filled with the most characteristic species and genera of living mollusks. The gallery is also occupied in part by the Beck collection of minerals. As containing types of the collections of minerals made by the New York Geological Survey it is unique and valuable. Additional case room is needed for the better display of these minerals.

The most conspicuous addition made recently to the Museum is the skeleton of the whale which was caught in the Raritan river two years ago, which Sheriff E. F. Roberts very generously gave to the College. During the past summer Prof. F. C. Van Dyck and D. C. Van Dyck, a former student of the Scientific School, mounted this skeleton, suspending it in the centre of the room, near the level of the gallery floor. It illustrates on a large scale to the student of anatomy the mammalian skeleton, and becomes a type in a series of such forms.

A human skeleton, the gift of Prof. J. S. Mosher, M. D., of the Albany Medical College, and a former student of Rutgers, has also been set up the past summer.

These statements indicate an increase in the attractive objects of the collection, as well as in valuable specimens for aid in teaching. The general aim has been to secure illustrative and useful material, rather than curiosities or the multiplication of duplicates. The filling in of gaps must be continually carried on as the general lines indicate the direction. The wants of the Museum are large, since no collection is too full for the complete

survey of any department of natural history, although quite adequate to the more limited requirements of the ordinary college student; but for a scientific school and for specialists, it cannot outgrow their needs.

VII. THE AGRICULTURAL DEPARTMENT AND STATE FUND.

The operations of the Agricultural Department during the past year and its present condition, are sufficiently set forth in the accompanying report of the professor in charge. It is only necessary to say that it has never been in more promising condition than at the present time.

The amount of money received from the State Treasurer for the fiscal year ending October 31, 1877, is six thousand nine hundred and sixty dollars ($6,960.00), which has been expended, as the law requires, exclusively for the salaries of professors in the Scientific School.

Respectfully submitted,

WM. H. CAMPBELL,

President of the Board of Trustees.

Report on the College Farm.

ANNUAL REPORT OF THE FARM OF THE STATE AGRICULTURAL COLLEGE FOR THE YEAR 1876–7.

GEORGE H. COOK.

The season just passed has been more than usually fruitful. The weather has been without marked extremes of heat and cold, and the rains though light have been timely, with a slight exception in parts of August and September, when a moderate drought checked the growth of pastures and root crops. The annual rain fall at New Brunswick is shown in the following table, for which the records up to 1869 were made at Rutgers College, and the later by P. Vanderbilt Spader, Esq., at his residence, corner George and Church streets, New Brunswick; and those for 1876–7 have been made at the College Farm:

TABLE OF RAINFALL AT NEW BRUNSWICK FOR TWENTY-FOUR YEARS.

Month.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	Monthly Average.
January	2.00	3.05	3.73	3.48	3.30	4.43	2.61	3.81	5.37	4.16	1.66	3.00	1.65	0.64	3.88	3.49	4.53	4.14	1.70	5 33	4.33	3.64	0.91	2.03	3.30
February	4.82	2.51	0.79	1.18	1.91	3.23	1.60	1.92	2.63	3.32	0.46	4.15	4.76	6.01	2.20	5.84	4.88	3.77	1.66	3.72	2.90	3.81	3.37	1.22	3.01
March	1.16	1.80	3.01	0.97	1.90	6.04	0.80	3.50	3.70	5.04	3.79	3.98	1.68	2.38	2.05	4.87	4.36	5.09	4.19	2.39	2.06	4.30	5.10	5.66	3.24
April	9.22	2.21	3.76	6.24	4.01	4.56	1.85	5.05	3.58	5.30	3.76	2.31	3.08	1.99	4.99	1.62	5.87	3.22	2.15	5.12	8.25	2.84	2.37	3.18	4.09
May	4.12	3.54	3.24	5.10	4.80	1.82	5.63	5.52	1.93	3.11	6.12	6.10	4.30	6.45	7.57	5.18	3.15	3.50	2.45	4.26	1.85	1.77	2.49	1.10	4.03
June	3.65	4.83	1.83	3.71	0.24	4.68	2.28	2.52	6.81	1.80	1.95	1.42	2.91	10.90	6.41	5.57	5.91	5.90	3.85	3.88	3.05	4.56	.82	5.35	4.09
July	3.63	3.17	1.92	4.20	2.85	3.47	2.72	1.26	5.74	10.42	1.59	7.73	2.91	5.03	6.26	3.61	4.66	8.91	8.97	9.47	4.02	3.94	1.59	2.67	4.75
August	1.48	2.48	6.03	6.16	3.00	4.88	11.52	3.04	1.13	3.45	3 13	3.08	7.07	8.45	3.55	0.70	6.70	9.25	7.12	10.7	2.35	8.08	0.76	4.54	5.13
September	2.67	2,66	4.71	3.35	1.54	7.20	4.32	2.41	2.80	0.98	4.07	2.51	5.84	0.34	7.59	2.34	3.08	2.39	3.01	3.59	8.61	2.19	6.04	1.40	3.46
October	1.70	3.84	0.90	3.91	2.01	1.81	3.02	2.59	5.20	3.12	2.27	4.45	3.83	4.18	1.34	8.53	5.60	5.51	4.09	4.65	2.66	2.62	.70	6.38	3.66
November	3.21	2.48	2.98	0.00	3.56	3.58	6.27	8.77	5.11	2.29	4.47	3.41	2.61	1.68	4.94	3.76	1.91	4.19	4.04	4.35	2.44	4.37	3.63	.....	3.71
December	2.39	5.81	3.17	5.93	4.23	3.97	3.44	1.90	1.13	5.12	4.82	5.95	2.83	1.27	3.32	4.86	2.34	2.31	4.70	2.40	2.78	2.76	3.43	.....	3.78
Total for the year	40.05	38.38	36.07	44.2	33.35	49.67	46.06	42.29	45.12	48.11	38.03	48.09	43.47	49.32	54.10	50.37	52.99	58.18	47.93	59.95	45.30	44.88	30.33	.....	45.85

Greatest annual rain fall	59.95
Least annual fall	33.35
Yearly average for 23 years	45.45
Greatest monthly rain fall	11.52
Least monthly rain fall	0.00
Average monthly rain fall	3.84

The year 1877 followed one of unusual dryness. The total amount of precipitated moisture in 1876 was 30.33 inches, which was three inches less than that of 1858 and more than fifteen inches less than the mean annual fall through a period of twenty-four years. The drought which began in the winter of 1875–6 and which continued more or less through 1876 extended into last winter. The rain and snow of the three winter months amounted to 6.01 inches, or less than two-thirds of the average for our winters. During the month of March there were several rain falls, but none of them were heavy. April and May were dry. The summer months were marked by frequent showers which brought up the average nearly to that of previous summers. From the 25th of August to the 4th of October, a period of quite six weeks, there was only one storm which gave a measurable fall of rain and that was only 1.40 inches. In general, the year to date has been marked by the frequency of light rains. The heaviest fall from the beginning of the year to the middle of June was scarcely an inch of water. These spring and summer rains were absorbed by the surface soil and in part evaporated quickly so that the springs did not get filled up.

CROPS.

Wheat.—This grain did not yield as heavily as last year. It was good, however. The field on which it was grown contains 13 acres. The soil is a gravelly loam, part of it with a flat surface and under-drained, and the rest a knoll naturally drained. The preceding crops were oats on between 10 and 11 acres, and potatoes on the rest; and all the ground was in good condition. Four acres, the best of the field, were sown with Clawson or Seneca wheat, which yielded 94 bushels, or 23½ bushels an acre. Nine acres were sown with Fultz wheat, and the crop obtained was 234 bushels, being 26 bushels an acre. On our soil the Fultz wheat has yielded better than any other, every year we have tried it. In appearance, when standing, it does not equal any of the other common varieties; the straw being shorter and the heads less bristling. The kernels, too, are smaller, but there are many more of them.

Rye.—Of this grain we raised an acre and sixty hundredths. It was sown on our best ground, near the barn, being intended for green fodder for cows, if it should be needed. It was sown early in September, three bushels of seed to the acre. It grew well, and the straw was so tall and heavy that much of it was lodged. The straw and grain, when taken from the field to stack, weighed 6½ tons. The rye was 80 bushels, or 50 bushels to the acre. The crop preceding the rye was fodder corn, for which the ground was heavily dressed with barnyard manure.

When the rye was sown the ground was dressed with *lute*, a refuse material from the gas works, using 75 bushels an acre. *Lute* is a mixture of clay and lime, which has been used for closing the joints in the covers of gas retorts, where it has been very hot, and afterwards has been thrown away.

Oats.—Eleven acres of oats were grown on the corn ground of last year. The crop is a good one, but it is not yet threshed out so that we can give the amount. A part was White Canadian oats from the Department of Agriculture, in 1876. It is a superior variety, ripening two or three days earlier than common oats, and weighing 36 pounds per bushel.

Corn.—Thirteen acres of corn were planted all on sod ground; 8 acres were in one field which had been in grass for several years, and 5 acres in another field which was in wheat last year, and had been spoiled for meadow by having the grass killed by drought. The 8 acre field was sloping ground, and naturally drained, except a very small portion on one side. The 5 acre field was on flat ground, which had been well underdrained. The corn was manured in the hill with a handful of compost of hen manure and coal ashes, but no other manure was used. The whole crop was 800 bushels of ears. The corn on the 5 acre lot was very much the best, this was owing to the ground being underdrained, as is proved by the results of the experiments on corn in several plots, as detailed further on in this report. Our subsoil is very close, and even on our highest ground it does not let the water from heavy rains sink away fast enough. Where there were no underdrains, the water, after heavy showers, remained among the corn roots long enough to damage them materially. The same effect has been noticed one or two seasons before this.

Potatoes.—This crop was grown in three plots, one of $1\frac{3}{4}$ acres, which was in carrots last year and well manured from the barnyard this season, yielded 240 bushels, or 137 bushels to the acre; another of $\frac{1}{4}$ an acre on our best corn ground of last year, which was manured with Forrester's potato fertilizer, and produced a crop of 40 bushels, or 160 bushels an acre; and a third small plot, from which 30 bushels were dug Our subsoil is too close for the best growth of potatoes, but the crop about pays, and it leaves the ground in such good condition for the following crops of wheat and grass that we prefer it to following the usual rotation in which oats comes between corn and wheat.

Carrots.—Two acres of carrots were grown this year on our driest ground, which was manured with 15 loads per acre from the barnyard, and 500 pounds of Lister's super-phosphate was

used on one acre, and 500 pounds of the U. S. Fertilizing Co.'s phosphate on the other. The carrots were planted in rows 30 inches apart. The crop was 810 bushels, or 405 bushels an acre, and 100 bushels of yellow globe turnips were grown in the blanks in the carrot rows. The whole expense for labor in plowing, manuring, cultivating, weeding and gathering was $92.50, and the manure was worth at least $80 more, of which half may be left in the ground. This leaves the cost of the crop $132.50, besides the interest on the ground. The carrots will sell for $35 a hundred bushels, or $283.50, and the turnips for $20, making the whole crop $303.50, from which, deducting $132.50 expenses paid out, we have $171, or $85.50 an acre, to pay the interest on land, cost of marketing, and profits.

Mangold Wurzels.—This root crop was grown on 1 3-5 acres of land. It was near the barn, and the ground was very good; 12 loads of barnyard manure and 600 lbs. of Lister's super-phosphate were applied to the acre. Seven hundred and fifty bushels of mangolds and 104 bushels of yellow globe turnips were gathered from the plot, being 470 bushels of mangolds and 65 bushels of turnips per acre. The whole expense for labor in plowing, manuring, planting, cultivating and gathering the crop was $70.75, and the half worth of the manure was $30, or the cost for the beets and turnips was nearly twelve cents per bushel, besides the interest on the capital invested. There is no sale for the mangolds; they are grown for cattle food, and are specially liked on account of their keeping qualities, as they are not liable to rot, even if kept in the cellar the year round.

Turnips.—Two acres of rutabagas were cultivated. The growth was checked by dry weather, and only 325 bushels were gathered from the field, or 162 bushels an acre. Norfolk whites were grown on 11-20 of an acre, and the crop was 120 bushels. These are not equal to the yellow globe in quality or productiveness. Rutabagas find a ready market at moderate prices, and are raised as a staple crop. They require less barnyard manure than the beets, and can be grown with superphosphates. Other turnips are grown, more as a catch crop, on any land that happens to be vacant. They grow quickly, and are valuable for cattle food.

Cabbage.—Two and one-fifth acres were planted with cabbage. The land was heavily manured from the barnyard, and the plants grew finely and headed well. The market, however, has been overstocked, so that prices have been very low and sales dull. From $1.50 to $2 per hundred is all the cabbage would bring. This is only from $60 to $80 an acre for a crop which costs heavily for labor and manures.

Hay.—The hay crop was very short. The drought of last year killed so many of the grass roots that it was very thin on the ground. From 27 or 28 acres of meadow we got only about 35 tons of good hay. With the heat of our summers, timothy dies out very rapidly, and last year it suffered so much worse than usual that all the ground then in grass must be ploughed and re-seeded before it will produce a good crop of hay.

Fodder Corn.—Two plots of fodder corn were grown, one 1¼ acres near the pond, and another of 1 1-10 acres about the middle of the farm. The former was an extraordinary growth—seeded with 3 bushels to the acre, and sown broadcast, it grew very tall and thick. Part of it was fed out green, and the rest was not all weighed, but judging from the quantity and weight of that now standing dry in shocks there could not have been less than 10 or 12 tons of dry fodder on this plot.

Pasture.—Five acres of ground is appropriated to pasture, partly for the feed it yields, and partly as an exercise ground for the cattle which are mainly kept in the stable and fed with green fodder, hay, straw, cornstalks, roots and corn meal, the produce of the farm, and whatever feed additional it is found most economical to buy.

STOCK.

Cows.—Thirteen cows have been kept on the farm during the year, and one bull, two yearling Ayrshire heifers and two Ayrshire heifer calves are being raised; 6 of the cows are Ayrshires, the others natives or grade stock. The milk is all sold to consumers in New Brunswick. In the past 12 months 32,803 quarts have been sold and 1,000 quarts have been fed to calves; this gives an average of 2,660 quarts yearly for each cow, and a daily average of a little over 7 quarts.

Swine.—We have now a stock of the Jersey Red swine, a breed which has held its place in Burlington and portions of Monmouth counties for perhaps a hundred years. It has great vigor of constitution, grows to a large size, will thrive on grass alone, or will well repay liberal feeding. It has maintained its place in the estimation of our most successful breeders against all the newer breeds which have been introduced among our farmers. Beginning last year with a boar and two sows, we have now several breeding sows, and aim to have a stock of the best specimens of the breed.

Horses and Mules.—These animals are kept only for work,

none are bred on the farm. Four horses and two mules do the farm work, the marketing and carrying round the milk.

SHEEP.—Are not kept on the farm, as there are no fences except for the small pasture lot.

FERTILIZERS.

In addition to the manure from the cow and horse stables, and from the pig styes, we have used this year Lister Brothers' standard superphosphate of lime, ammoniated dissolved bone, and bone dust; Peter Cooper's fine bone dust; C. V. Mapes' Peruvian guano, rectified and guaranteed; Forrester's fertilizer for potatoes, corn, and cabbages; U. S. Fertilizing Company's superphosphate; muriate of potash; potash salts; sulphate of ammonia; leached wood ashes; shell marl, and malt kiln dust.

ANALYSES.

Lister's Standard Bone Superphosphate.

Phosphoric acid, soluble,	6.91
" " reverted,	4.09
" " in bone,	2.82
Potash,	1.70
Ammonia,	2.73

Lister's Ground Bone.

Phosphoric acid, soluble,	1.60
" " in bone,	11.79
Ammonia,	3.70

Peter Cooper's Fine Bone Dust.

Phosphoric acid,	30.72
Ammonia,	2.20

Guaranteed Guano from C. V. Mapes.

	1	2
Phosphoric acid, soluble,	5.76	4.61
" " insoluble,	13.70	13.57
Ammonia,	9.37	6.42
Potash,	.....	2.90

Rectified Guano, from C. V. Mapes.

Phosphoric acid, soluble,	12.67
Ammonia,	10.56
Potash,	1.80

Muriate of Potash.

Containing of pure potash, - - - - - 50 per cent.

Potash Salts.

Containing of pure potash, - - - - 45 per cent.

Sulphate of Ammonia.

Containing of pure ammonia, - - - - 25 per cent.

Leached Wood Ashes.

Carbonate of lime,	70.5
Phosphoric acid,	1.6
Potash,	a trace.

Shell Marl.

Consisting mainly of fine carbonate of lime.

Dust from Malt.

Phosphoric acid,	1.73
Ammonia,	5.60
Potash,	2.19

National Soluble Bone.

Phosphoric acid, soluble,	8.32
" " reverted,	3.52
" " insoluble,	5.12

The prices of the fertilizing elements in these commercial manures varies somewhat from year to year. The Connecticut Agricultural Experiment Station has given a list of prices, of which the following is nearly an equivalent:

Ammonia in ammoniacal salts and nitrates, per pound, 20 cents.
" " Peruvian Guano, fine steamed bone, dried and fine ground blood, meat and fish, 16½ "

Ammonia in fine ground bone, horn and wool dust,	15	cents.
" " coarse bone, horn shavings, and fish scraps,	12½	"
Phosphoric acid soluble in water,	12½	"
" " reverted, and Peruvian guano,	9	"
" " insoluble in fine bone and fish guano,	7	"
" " in coarse bone, bone ash and bone black,	5	"
" " in fine ground rock phosphate,	3½	"
Potash in high grade sulphate,	9	"
" " kainite, as sulphate,	7½	"
" " muriate, potassium chloride,	6	"

This list of prices is used for computing the value of any commercial fertilizer, of which the analysis or composition is known. Since the analysis gives the weights of the several constituents found in 100, and a ton is 20 hundreds, it follows that if the weights in the analysis are multiplied by 20 the products will be the quantities of each in a ton, and these quantities being multiplied by the prices above given will show the values of each, and adding them together will give the value of the fertilizer. For example the guaranteed guano of the preceding analysis is worth $76.61 per ton; the Lister's super-phoshate, $40.12; Peter Cooper's fine bone dust, $49.60; and the dust from malt $24.87 per ton; and others are computed in the same way.

The calculated values do not of course always correspond to the values which are ascertained by farmers from their experience on their own peculiar soils, or on special crops, but they give an approximate value, and help to guide the judgment of those who use them.

EXPERIMENTS.

On Indian Corn the experiments with different fertilizers have been continued this year as for several years past. The plots contained one-tenth of an acre each, but the results in the table are put down at the rates per acre.

MANURES.	NUMBERS OF THE PLOTS AND POUNDS IN EACH.									
	1	2	3	4	5	6	7	8	9	10
Sulphate of ammonia	.....	300	.....	.....	.....	200	100	.....	.....	.....
Superphosphate of lime	.....	.....	500	.....	.....	300	500	.....	.....	.....
Muriate of potash	.....	.....	.....	150	.....	150	150	.....	.....	.....
Mixed potash salts	.....	.....	.....	.....	.....	.....	.....	150	.....	.....
Forrester's corn fertilizer	.....	.....	.....	.....	.....	.....	.....	.....	758	.....
Barnyard manure	.....	.....	.....	.....	.....	.....	.....	.....	.....	32,000
CROPS.										
Ears of corn, pounds	5,290	5,650	3,900	4,020	3,630	5,340	5,350	5,310	5,230	4,690
Bushels of corn, 80 pounds each	66.1	70.6	48.7	50.2	45.4	66.7	66.9	66.4	65.4	58.6
Corn stalks, pounds	3,750	4,000	4,000	4,250	4,450	4,700	4,300	4,400	4,450	3,650
Cost of manure, per acre	$0 00	$15 00	$8 00	$4 50	$0 00	$19 50	$17 50	$4 50	$15 00	$32 00

These experiments were tried on a plot of ground which has every appearance of being of uniform quality, and was so considered. The results not agreeing well with those obtained in former years, an examination of the field was made, and it was found that an underdrain ran across plots 1 and 2, while the rest are on undrained soil. To this difference the large yield of corn in those two plots is attributed. If the remaining plots may be taken to fairly show the effect of the fertilizers, as I think they may, they show that for corn, on sod ground, the only commercial fertilizers that give us returns at all commensurate with their cost, are those containing a considerable amount of potash.

On Wheat, experiments were made with the two samples of Guaranteed Guano and the sample of Rectified Guano, given in the analyses of fertilizers. A bag containing about 200 pounds of each was used on separate half acres of ground. They were sent by Charles V. Mapes, and were received late in October. They were tried on a field in good condition, from which a crop of potatoes had just been taken. The time of sowing was some weeks later than is thought safe for large crops of wheat.

The Guaranteed Guano, No. 1, yielded	15	bushels,	or	30	bushels	per acre.
The Guaranteed Guano, No. 2, yielded	14¾	"	"	29½	"	"
The Rectified Guano yielded	15¾	"	"	31½	"	"
No Manure yielded	13½	"	"	27	"	"

The guanos were worth about $5 each. The rectified guano produced the largest crop. It was too late in the season or much larger crops would have been obtained. As it was, however, the increased amount of wheat sold for $7.50 more than that from from a like portion of unmanured ground. This is half the worth of the guano, and is as much as may ordinarily be expected from a single crop. The remainder is in the ground, and will help the succeeding crops. The whole field was sown with clover and timothy seed. The clover has grown about equally well on all the plots, and is very good. The timothy has grown but very little on the plot to which no guano was applied, while it has grown to a complete mat of grass where the guano was used. If the present promise is fulfilled, we shall get the value of the guano in the coming hay crop.

Sugar Beets were grown on the college farm in 1871 and 1872, and the crop was carefully tended, and at the close of the season was gathered, weighed, and the amount of sugar in the beets was determined. In 1871 the seed was from the Silesian sugar beet, got at a sugar house in Halle, Germany, and from the Nursery beet, a French Vilmorin sugar beet, from Carter, in London. The Silesian yielded 16 8-10 tons to the acre, and the Nursery only 9 tons. The beets averaged about two pounds.

The sugar was determined in them, and found to be 11.04 per cent. in the Silesian, and 8.24 in the Nursery.

In 1872 the beets were from Silesian sugar beet seed sent by the Department of Agriculture. The yield was 14 tons an acre. They were not analyzed for sugar, but were presumed to be the same in quality with those of 1871.

In 1873 Silesian sugar beets were grown from seed sent by the U. S. Commissioner of Agriculture. They were planted on ground that was manured with 16 loads of barnyard manure and 600 pounds of an equal mixture of German potash salts and superphosphate of lime per acre. The crop was 15 tons per acre. The beets were very sweet, yielding, with our imperfect means of extraction, 8 per cent of sugar.

These are satisfactory results, and show that beets for making sugar can be grown here sufficient in richness and quantity to supply the material for this manufacture, the quality and amount of crop being about the same as that of the average crop in countries where sugar making is carried on as a large and profitable business. The attention now given to this branch of agricultural industry, and its importance to our whole country, makes it desirable to again report these experiments of four, five, and six years ago.

DONATIONS.

From Messrs. Lister Brothers, of Newark, six tons of their Standard Bone Manures.

From Charles V. Mapes, of 158 Front street, New York, five bags, of about 200 lbs. each, of Commercial Fertilizers, viz.: 1 bag of Mapes' Wheat and Grass Fertilizer, 1 bag of Mapes' Superphosphate of Lime, 1 bag of Fine Bone, 1 bag of Medium Bone, and 1 bag of Coarse Bone.

From H. J. Baker & Brother, of 215 Pearl street, New York, 1 barrel of Forrester's Potato Fertilizer, 1 barrel of Forrester's Corn Fertilizer, and 1 barrel of Forrester's Cabbage Fertilizer.

From John Crane, of Union, Union county, Dalley's Stock Feed Steamer and Evaporator.

The thanks of the Trustees of Rutgers College are hereby tendered to these friends of agricultural improvement who have so liberally aided them in carrying on their useful but expensive work.

Courses of Study.

Three distinct courses of study are included in the Schedule which follows:

I. A Course in Civil Engineering and Mechanics.

II. A Course in Chemistry and Agriculture.

III. A Special Course in Chemistry.

During the first and second year the studies of the two full courses are the same, and are designed to furnish a suitable introduction to the pursuit of the higher branches in either.

During the last two years the subjects of Higher Mathematics, Mechanics and Engineering in the Engineering Course are replaced by Analytical Chemistry, practice in the Laboratory, and Agriculture in the other. The remaining subjects are pursued by the students of both courses together.

The course of study for the first two years in this Department is arranged so as to be complete in itself. It is especially designed to meet the wants of those who cannot take the entire four years' course, but who desire to fit themselves as Land Surveyors. Students leaving at this period of the course, receive from the Faculty a certificate of their attainments.

Special Students are received, and allowed to take any part of the above course; and particular provision is made for them, especially in the Laboratory, in Mathematics and Surveying.

The Special Course in Chemistry and Agriculture, occupying two years, is designed for those who wish to devote themselves exclusively to these branches. Opportunities of a very superior character are afforded to such students under the charge of Professors Cook, Smock and Van Dyck, in the new Laboratory building.

Special provision is also made for students who desire, after completing the regular course of study, to take post-graduate studies.

COURSE OF STUDY.

FRESHMAN YEAR.

Exercises during the year in Composition and Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. French. 2. Mathematics—Loomis' Algebra, from Quadratic Equations. 3. Natural History—Dalton's Physiology; Lectures. 4. Rhetoric—Haven; Lectures. 5. Draughting—Construction of Problems.

SECOND TERM.

1. French. 2. Mathematics—Loomis' Geometry, from Book IV. 3. Natural History—Zoology; Lectures. 4. Elocution—Lectures. 5. English Literature—Shaw's Manual; Craik's English of Shakespeare. 6. Draughting.

THIRD TERM.

1. French. 2. Mathematics—Loomis' Trigonometry, Plane and Spherical. 3. Natural History—Gray's Botany; Lectures. 4. English Literature—Shaw's Manual; Lectures. 5. Draughting.

SOPHOMORE YEAR.

Exercises during the year in Composition and Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. Surveying—Murray's Manual; Field Exercises and Mapping. 2. Descriptive Geometry—Church. 3. Chemistry—Lectures. 4. Mental Philosophy—Haven. 5. History—Freeman's Outlines.

SECOND TERM.

1. Descriptive Geometry—Church; Construction of Problems. 2. Chemistry—Lectures. 3. Mental Philosophy—Haven. 4. History—Freeman's Outlines.

THIRD TERM.

1. Leveling and Railroad Curves—Henck's Field Book; Field Practice and Plotting. 2. Shades, Shadows and Perspective—Church; Construction of Problems. 3. Chemistry—Lectures. 4. Mental Philosophy—Lectures. 5. History—Creasy's Constitutional History of England.

JUNIOR YEAR.

Exercises during the year in Composition and Original Declamation. Bible Class each Sabbath morning.

Course in Civil Engineering and Mechanics.

FIRST TERM.

1. German. 2. Analytical Geometry—Peck. 3. Natural Philosophy — Snell's Olmsted. 4. History of Civilization—Guizot. 5. Constitutional History of the United States—Text book and Lectures. 6. Draughting.

SECOND TERM.

1. German. 2. Differential and Integral Calculus—Peck. 3. Natural Philosophy — Snell's Olmsted. 4. Political Economy —Bowen and Perry. 5. Constitutional History of the United States—Text book and Lectures. 6. Draughting.

Course in Chemistry and Agriculture.

FIRST TERM.

1. German. 2. Mineralogy and Analytical Chemistry—Text book, with Laboratory Practice. 3. Agriculture—Lectures at the Farm. 4. Natural Philosophy—Snell's Olmsted. 5. History of Civilization—Guizot. 6. Constitutional History of the United States—Text book and Lectures.

SECOND TERM.

1. German. 2. Analytical Chemistry — Text book, with Laboratory Practice. 3. Agriculture—Lectures. 4. Natural Philosophy — Snell's Olmsted. 5. Political Economy — Bowen and Perry. 6. Constitutional History of the United States—Text book and Lectures.

THIRD TERM.

1. German. 2. Mechanics—Bartlett or Smith. 3. Astronomy—Loomis. 4. International Law—Woolsey. 5. Draughting.

THIRD TERM.

1. German. 2. Analytical Chemistry—Text book, with Laboratory Practice. 3. Agriculture—Vegetable Physiology. 4. International Law—Woolsey.

SENIOR YEAR.

Exercises during the year in Composition and Original Declamation. Bible Class each Sabbath Morning.

Course in Civil Engineering and Mechanics.

FIRST TERM.

1. Mechanics — Bartlett or Smith. 2. Geodesy — Theory and Practice of Triangulation. 3. Chemistry—Lectures on Organic Chemistry. 4. Moral Philosophy — Wayland and Hopkins.

SECOND TERM.

1. Engineering — Mahan. 2. Geodesy—Practical Astronomy; Indeterminate Analysis. 3. Chemistry—Lectures on Chemical Physics. 4. Moral Philosophy—Butler's Analogy.

THIRD TERM.

1. Engineering—Bridge Building and Railway Practice. 2. Architecture—Lectures. 3. Geology—Lectures; Geological Excursion. 4. Moral Philosophy—Butler's Analogy.

Course in Chemistry and Agriculture.

FIRST TERM.

1. Mining and Metallurgy. 2. Chemistry and Principles of Agriculture—Lectures. 3. Laboratory Practice. 4. Moral Philosophy—Wayland and Hopkins.

SECOND TERM.

1. Agriculture — Its Methods and Products. 2. Chemistry—Lectures on Chemical Physics. 3. Laboratory Practice. 4. Moral Philosophy—Butler's Analogy.

THIRD TERM.

1. Agriculture—Animal Physiology; Care and Management of Domestic Animals. 2. Architecture—Lectures. 3. Geology—Lectures; Geological Excursion. 4. Moral Philosophy—Butler's Analogy.

SPECIAL COURSE IN CHEMISTRY.

FIRST YEAR—FIRST TERM.

1. Elements of Chemistry—Text book and Lectures. 2. Blowpipe Analysis. 3. Elements of Mineralogy.

SECOND TERM.

1. Physics and Chemistry—Text book and Lectures. 2. Chemical Analysis—Qualitative.

THIRD TERM.

1. Chemical Analysis—Qualitative and Quantitative. 2. Vegetable Physiology.

SECOND YEAR—FIRST TERM.

1. Chemical Analysis—Analysis of Minerals, Ores, &c. 2. Mineralogy—Determinative.

SECOND TERM.

1. Chemical Physics—Heat, Electricity, Magnetism, Galvanism and Electro-magnetism—Text book and Lectures. 2. Analysis of Fertilizers and Chemical Products.

THIRD TERM.

1. Lectures on Geology. 2. Chemical Analysis—Special Investigations.

Contents.

List of State Board of Visitors, - - - - - - - - - Page 3
Report of State Board of Visitors, - - - - - - - - " 5
Report of the Board of Trustees, - - - - - - - - " 9
Report on the College Farm, - - - - - - - - - " 21
Courses of Study, - - - - - - - - - - - - - - " 33

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